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(54) Title: METHOD AND DEVICE FOR CHILLING THE INTERIOR SPACE OF A REFRIGERATED TRANSPORTING VEHICLE

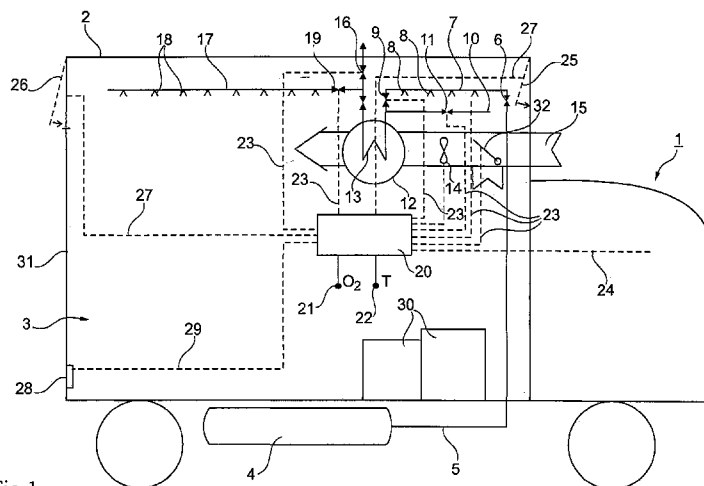


Fig 1

(57) Abstract: The present invention relates to a method and to a device for chilling an interior space (3) of a refrigerated container (2), especially of a transporting vehicle (1) for refrigerated goods (30), wherein liquid nitrogen is used as chilling medium. The nitrogen in a direct chilling phase is sprayed directly into the interior space (3), wherein at least some of the nitrogen before spraying passes through a heat exchanger (12) with a heat exchanger mass (13) and cools this, and in an indirect chilling phase environmental air is blown through the cooled heat exchanger (12) into the interior space (3). The device according to the invention preferably has a tank (4) for liquid nitrogen which via a feed line (7) which is provided with discharge openings (8) is connected on the primary side (13) to the heat exchanger (12), so that some of the liquid nitrogen which is fed to the heat exchanger (12) can already be sprayed from the feed line (7) into the interior space (3), and the heat exchanger (12) on the primary side (13) has a discharge line (17) for nitrogen, which is provided with discharge openings (18), through which nitrogen can be sprayed into the interior space (3) after exposure of the heat exchanger (12) to throughflow. The controlling of the direct chilling phase, or the switching to or starting of the indirect chilling phase, is carried out preferably via the oxygen concentration in the interior space (3) as a controlled variable, wherein a specifiable threshold value, which can be selected so that entering of the interior space (3) is possible at any time or after only brief ventilating, is not fallen short of.



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Method and device for chilling the interior space of a refrigerated transporting vehicle

The present invention relates to a method for chilling an interior space of a
5 refrigerated container, especially of a transporting vehicle for refrigerated goods,
using liquid nitrogen as chilling medium, and also to a corresponding device.
Refrigerated transporting vehicles are used for the transporting and the
distribution of refrigerated goods. In general, it concerns a motor lorry with a
rigid construction, but the present invention can also be applicable for transport
10 containers or other refrigerated units. It is even possible to couple chilling
systems according to the invention to larger spaces for their chilling.

Different transportation tasks demand respectively adapted solutions, of which a
large number are even known already. In the simplest case, the interior space of a
15 transporting vehicle can be kept at a defined chilling temperature by means of a
mechanical chilling unit, wherein the chilling unit can be driven either by an
internal combustion engine or by an electric motor. Such systems are suitable for
the maintaining of a defined chilling temperature in the interior space of the
transporting vehicle during long transporting operations, but its chilling capacity
20 is not adequate under circumstances when the interior space is opened relatively
frequently, which, for example, occurs during the distribution of refrigerated
goods to a lot of customers who are located relatively close to each other.

Energy costs also play an ever greater role for the complete maintaining of a
25 chilling chain. From these points of view, refrigerated transporting vehicles were
also developed, during the chilling of which liquid nitrogen is used as chilling
medium. This is carried along in a typical manner in a cryotank in or on the
refrigerated transporting vehicle and can provide a large chilling capacity,
especially through the phase transition from liquid to gaseous.

30

A disadvantage of chilling with liquid nitrogen is that in the case of direct

spraying-in of nitrogen into the interior space, a non-breathable atmosphere for people can be created there, in the extreme case with only very little oxygen content. Although the direct spraying-in of liquid nitrogen into the interior space is the quickest chilling method, the reproduction of a breathable atmosphere
5 means a time and energy loss in each case, which is very unsuitable particularly during uses with frequent entering of the interior space. Indirect chilling systems, therefore, were also developed, in which the liquid nitrogen is not sprayed directly into the interior space, but is diverted through a heat exchanger into the environmental air, and wherein at the same time the air in the interior space is
10 directed through the heat exchanger and in a chilled state is directed into the interior space again. This chilling method, with reasonable dimensioning of the heat exchanger, cannot provide in the short term as much chilling capacity as liquid nitrogen which is sprayed in directly.

15 A combined system consisting of direct and indirect chilling with liquid nitrogen is also known from EP 1 252 471 B1. In the case of this combination, the chilling is first carried out by spraying in liquid nitrogen, but stopped before the interior space is to be opened. An indirect chilling with environmental air which is guided through a heat exchanger is then carried out for a time so that a breathable
20 atmosphere is created again in the interior space. The direct and the indirect chilling systems are formed as independent parallel systems and are operated only alternatively. This results in certain delays after shutting down the direct system before the indirect chilling becomes effective and has created a breathable atmosphere again in the interior space.

25

It is the object of the present invention to disclose methods and devices for chilling an interior space of a container, especially of a transporting vehicle for refrigerated goods, in which a direct and an indirect chilling system interact energetically and temporally particularly well, wherein at any time a breathable
30 atmosphere is to be available in the interior space or is to be at least recreatable within an extremely short time. Since an indirect chilling system is typically

operated with an electric fan, which during longer standing times of a transporting vehicle, for example overnight, can excessively load a vehicle battery, a preference of the direct chilling which cares for the battery and is energetically favourable is also to be made possible by different measures as a partial object of
5 the present invention.

A method according to Claim 1 and a device according to Claim 10 serve for achieving this object. Advantageous developments, which can be used individually or in combinations with each other, are disclosed in the respective
10 dependent claims.

The method according to the invention for chilling an interior space of a container for refrigerated goods, using liquid nitrogen as chilling medium, is characterized in that the nitrogen in a direct chilling phase is sprayed directly into the interior
15 space, wherein, however, at least some of the nitrogen, before spraying, passes through a heat exchanger with a heat exchanger mass and cools this so that in a simultaneously or subsequently operating indirect chilling phase, the air mixture and/or environmental air which originated in the interior space can be blown through the cooled heat exchanger into the interior space. In the most favourable
20 case, this means that during switching from direct chilling to indirect chilling the nitrogen feed can be completely shut off because the heat exchanger is already cooled and the heat exchanger mass with its thermal capacity can maintain an indirect chilling for a certain time even without additional feed of liquid nitrogen to the heat exchanger. With a suitable design of the heat exchanger, this is
25 sufficient, for example, to blow that much chilled outside air into the interior space that there is approximately the same oxygen content there as in the environment.

If necessary, however, according to the invention, during an indirect chilling
30 phase, additional nitrogen for chilling can also be directed through the heat exchanger and then directed directly into the environment, while the air mixture in

the interior space and/or environmental air is additionally blown through the heat exchanger into the interior space. This is especially advantageous in the case of large interior spaces and dependent upon the load state during the delivery operation with frequent loading and unloading processes.

5

It has also become apparent that an alternative control philosophy of direct and indirect chilling systems which are entirely independent of the exact type of construction and logic operation leads to method variants which can ensure a quick accessibility of the interior space. In addition, the present invention
10 instructs that the direct chilling phase is terminated and, with requirement for further lowering of the temperature or for the maintaining of a low temperature, the indirect chilling phase is started, if the oxygen content in the interior space has dropped below a specified threshold value, for example below 15%, preferably below 12%. While during a long-lasting direct chilling almost all
15 the oxygen is displaced from the interior space so that it takes a relatively long time until a breathable atmosphere is created again, the solution according to the invention produces the effect of a breathable atmosphere being practically always available in the interior space. This has surprisingly shown that despite this a considerable portion of the chilling capacity can be brought about by means of
20 direct chilling, wherein in particular the series-connection according to the invention of the heat exchanger into the direct chilling system enables an energetically favourable alternate or simultaneous operation of the two systems.

If the oxygen content in the interior space is always kept above a defined
25 threshold value, for example 12%, then the interior space can be entered practically at any time. Upon shutting down the direct chilling and opening a door, the oxygen content alone is increased as a result of natural convection within a few seconds to such a degree there is a breathable atmosphere. If necessary, this can be supported by means of an indirect chilling with
30 environmental air shortly before and during the residence of a service person in the interior space. In the case of a threshold value above 14%, there is in fact

always a breathable atmosphere. It is therefore also possible to carry out a direct chilling up to an oxygen content of for example 14%, then by means of indirect chilling to recirculate the air mixture which is created in the interior space through the heat exchanger for an optional length of time and so to keep the interior space
5 chilled by means of recirculation chilling, or to chill it further, and to then directly enter the interior space.

An arrangement has proved to be especially advantageous in which liquid nitrogen is first fed to the heat exchanger through a feed line with discharge
10 openings, wherein only some of the liquid nitrogen is sprayed through the discharge openings into the interior space while the remainder reaches the heat exchanger, passes through this, and, via a discharge line which is provided with discharge openings into the interior space, is then used for further chilling of the interior space. This arrangement has the advantage that even in the case of a fully
15 heated-up heat exchanger, the direct chilling system develops chilling effect by means of the liquid nitrogen which issues from the feed line. The remaining nitrogen is possibly evaporated in the heated-up heat exchanger and therefore reaches the discharge line in only a gaseous state and with already increased temperature. If the heat exchanger were to be arranged at the very start of the
20 direct chilling system, then with the heat exchanger warmed-up the chilling system could not immediately develop an intense chilling effect. In the case of this preferred embodiment, by means of valves and bypass lines the ratio of directly sprayed liquid nitrogen to the ratio of the nitrogen which first passes through the heat exchanger can be changed or even controlled. The system is
25 therefore very flexibly adaptable to different situations of the chilling requirement. As soon as the heat exchanger has cooled down, it does not represent a disadvantage during further use of the direct chilling system but is available for an immediate operation of the indirect chilling system.

30 In addition, it is naturally simplest to keep the oxygen content in the interior space always sufficiently high to the extent that after opening a door a person can

directly enter the interior space without any risk. However, time periods may also be granted, for example after or during longer intermissions, in which it is permitted for the oxygen content in the interior space to become lower. For this case, it is advantageous that according to the invention all the doors for access
5 from outside to the interior space are locked provided that the oxygen content in the interior space lies below a specified access value.

A mode of operation in which the direct and the indirect chilling phases are in operation essentially at the same time is especially advantageous, wherein the
10 ratio of the quantities of directly sprayed-in nitrogen and indirect chilling of the air mixture in the interior space is controlled in dependence upon the oxygen concentration in the interior space, while the chilling is altogether controlled in dependence upon the temperature in the interior space. The basic principles of such a control are very simple: provided that the temperature in the interior space
15 lies within a desired nominal range, no chilling takes place at all. If the temperature is too high, then nitrogen is sprayed in until either the temperature again lies with the nominal range, or the oxygen concentration lies below the specified threshold value. If the temperature is still too high, but the oxygen content is below the threshold value then the indirect chilling phase is initiated
20 until the temperature reaches the nominal range.

A further measure according to the invention, which in the case of the described method can be advantageously additionally applied, but which can also generally be used during direct chilling operations independently of the exact method
25 control, is the possibility of automatically or manually switching from the direct chilling phase exclusively to the indirect chilling phase with environmental air, especially for a short time, for example for several minutes before an expected entering of the interior space. In practice, this means that either a navigation system triggers the switching before reaching defined destinations, or a driver of a
30 transporting vehicle effects the switching manually if he is just before a destination at which the interior space has be entered. As a result, upon reaching

the destination the interior space is already accessible again with a breathable atmosphere without waiting times occurring.

This process can be supported according to the invention by means of additional
5 means of ventilation for feeding possibly chilled environmental air into the interior space, for example by means of ventilation flaps, fans and suchlike. If necessary, the ventilating can even be supported by means of the head wind on a final part of the route before the destination.

10 A device according to the invention for chilling the interior space of a transporting vehicle for refrigerated goods has a tank for liquid nitrogen, a direct chilling system for spraying nitrogen into the interior space, and an indirect chilling system with a heat exchanger, which on the primary side is cooled by nitrogen, through which on the secondary side air mixture from the interior space and/or
15 environmental air can be directed into the interior space. The direct and the indirect chilling systems are interconnected so that the heat exchanger on the primary side can be connected in series to at least a section of the direct chilling system. Valves which allow the different operating modes at the same time or separately for the two chilling systems are preferably available. The advantage of
20 the series-connection is that the heat exchanger is already precooled when using the indirect chilling system, so that when engaging the indirect chilling system, or when switching to this chilling system, very intensely chilled air mixture from the interior space, or chilled environmental air, can immediately be directed into the interior space. In general, a heat exchanger has sufficient heat exchanger mass so
25 that sufficient cold can be stored in order to achieve an extensive exchange of the inner atmosphere with chilled environmental air without directing further nitrogen through the precooled heat exchanger. This operating mode amounts to an energetically especially good utilization of the cold store in the liquid nitrogen. When required, however, it should be possible to engage the heat exchanger so
30 that it is cooled by nitrogen, which is discharged into the environment, without reducing the oxygen content of the interior space.

As described, it is especially advantageous if the direct chilling system is equipped with a control circuit, the controlled variable of which is the oxygen concentration in the interior space, or is a measured variable which is physically associated with it. In the simplest case this can be a two-position control system which in general is superimposed on a temperature control system. In the case of known load space volumes, if necessary taking into account the volume of the loaded refrigerated goods, the direct chilling system can also simply be engaged for a tested, calculated or experimentally defined time period with a known quantity of sprayed-in nitrogen per unit of time, after the expiry of which it is then switched to indirect chilling. This course of action can also ascertain the falling short of the threshold value for the oxygen content without requiring measuring and control.

It has been shown that with typical load states and typical tailgates, for example at the rear end of a transporting vehicle, practically no risks can occur for people when entering the interior space if defined boundary conditions are observed. A reduced oxygen content in the interior space is compensated relatively quickly as a result of natural convection when opening a tailgate, in any case until a defined removal of the tailgate. Furthermore, a reduced oxygen content does not have an effect on the human organism within a few seconds so that chilling operations according to the invention when observing defined experience values do not imply any risks at all for the loading personnel, as a result of which control of the oxygen content can often be completely dispensed with if the experience values are based on safe boundary conditions.

An embodiment of the invention can be especially preferably and flexibly used in which the tank for liquid nitrogen, via a feed line which is provided with discharge openings, is connected on the primary side to the heat exchanger so that some of the liquid nitrogen which is fed to the heat exchanger can already be sprayed from the feed line into the interior space, wherein the heat exchanger on

the primary side has a discharge line for nitrogen, provided with discharge openings, through which nitrogen can be sprayed into the interior space after exposure of the heat exchanger to throughflow. The serial installation of the heat exchanger after a section of the direct chilling system has various advantages.

- 5 The discharge openings in the feed line first produce the effect of liquid nitrogen also being immediately sprayed into the interior space when putting the direct chilling system into operation when the heat exchanger is warmed up. Only some of the liquid nitrogen then serves for cooling down the heat exchanger, as result of which only gaseous nitrogen possibly first reaches the discharge line of the heat
- 10 exchanger and through its discharge openings reaches the interior space. In this way, both a quick direct chilling and an energetically favourable utilization of the nitrogen in the direct chilling system for cooling down the heat exchanger can be achieved.
- 15 In order to basically also enable an operation of only the indirect chilling system, corresponding bypass lines with valves and/or closable discharge openings can be provided. Valves, which enable defrosting of the heat exchanger without influencing the direct chilling, can also be provided.
- 20 If the controlling according to the invention includes the measuring of the oxygen content in the interior space, it is advantageous to provide locking of all the doors for access from outside to the interior space, which can be released from outside only when an oxygen content in the interior space is above a specified access value. The direct measuring of the oxygen content and the establishing of a
- 25 breathable atmosphere are safer than making the access dependent only upon a specified time span of the ventilation.

The design of the heat exchanger can be especially advantageously carried out so that the heat exchanger has a heat exchanger mass, the thermal capacity of which

30 is sufficient to blow adequately cold air into the interior space in order to increase the oxygen content from the lowest threshold value to an easily breathable

atmosphere and to maintain the desired temperature range for a certain time even in the case of repeated opening and closing of the doors without the refrigerated goods being warmed on its outer side. Chilling with direct or indirect chilling systems assumes that the interior space has gas outlets, especially gas outlets with
5 check valves, through which overpressure can escape from the interior space. Provided that interior spaces have additional flaps or openings, or additional ventilation systems are made available, then time gains can be achieved during delivery operations if ventilating by means of additional operations of these means of ventilation already directs environmental air, especially chilled
10 environmental air, into the interior space before reaching a loading or unloading point. In this case, even the headwind can possibly be utilized. In conjunction with an oxygen content in the interior space which anyway is not severely reduced, a breathable atmosphere can be quickly created in this way, as a result of which an immediate entering of the interior space after reaching the loading or
15 unloading point is possible. It is favourable if a driver intervention line enables the controlling of such measures from a driver's cab of the transporting vehicle.

Details of the invention are described in the following and based on an exemplary embodiment, to which the invention, however, is not limited, are shown in the
20 drawing. The figure shows in a schematic representation a transporting vehicle 1 with a refrigerated container 2, the interior space 3 of which is to be kept at a temperature which is colder in relation to the environment for storing refrigerated goods. A tank 4 for liquid nitrogen, from which a connecting line 5 leads into the interior space 3, is located beneath the refrigerated container. After opening a first
25 inlet valve 6, liquid nitrogen from there can reach a feed line 7 which has discharge openings 8 into the interior space 3. After opening a second inlet valve 9, liquid nitrogen reaches a heat exchanger 12, the primary side 13 of which especially comprises a cooling coil with a specified heat exchanger mass and specified thermal capacity. Via a discharge valve 19, the nitrogen reaches a
30 discharge line 17 with further discharge openings 18 into the interior space 3. The direct chilling system which is formed in this way allows the spraying of liquid

nitrogen into the interior space 3, as a result of which this can be cooled down very quickly, for example after a loading or unloading process. Since the heat exchanger 12 is connected into the direct chilling system by means of a series-connection, this heat exchanger 12 is cooled down to the temperature of the liquid nitrogen during operation of the direct chilling system. If the heat exchanger 12 is warm when putting the direct chilling system into operation, then it can be that liquid nitrogen from the discharge openings 8 of the feed line 7 indeed reaches the interior space, but first of all only gaseous nitrogen is discharged from the discharge openings 18 of the discharge line 17 because the heat exchanger 12 is cooled first down. This indeed reduces somewhat the chilling capacity of the direct chilling at the start but with a suitable design of the lengths of feed line 7 and discharge line 17 does not lead to malfunctions. Therefore, the heat exchanger 12 is at the temperature of the liquid nitrogen after a certain operating time of the direct chilling system. By means of the fan 14, as indicated by an arrow, environmental air can now be blown into the interior space 3 through an environmental air inlet 15, and/or, depending upon the position of a control flap 32, air mixture from the interior space 3 can be blown into the interior space through the heat exchanger 12. This can be carried out after shutting down the direct chilling system because the heat exchanger mass of the heat exchanger 12 contains enough cold energy for a certain operating time of the fan 14, for example has a thermal capacity of 100 kJ to 5000 kJ, preferably 200 to 1000 kJ. By means of a bypass line 10 and a bypass valve 11 and also a blow-off valve 16, a permanent indirect chilling can also be carried out upon shutting-off the first inlet valve 6 and the second inlet valve 9 and also the discharge valve 19, wherein the heat exchanger is supplied from the tank with liquid nitrogen without nitrogen being sprayed into the interior space 3. The exemplarily represented arrangement of the valves altogether enables different, very flexible operating modes of direct and indirect chilling systems simultaneously or selectively, wherein the indirect chilling can be a type of air recirculation chilling, or, when required, directs chilled outside air into the interior space for increasing the oxygen content. Combinations are also possible, depending upon whether the control flap 32 frees

only one path or partially opens two paths. By operation of the valves at defined intervals, or by means of valves which are controllable in their throughflow, a defined ratio of the direct to indirect chilling can even be adjusted.

- 5 A control and regulating unit 20, which is schematically indicated by its connecting lines, serves for the controlling or regulating of the chilling. It is connected to at least one oxygen sensor 21 and to at least one temperature sensor 22. From the measured values of the temperature and of the oxygen content, corresponding control commands are produced, which via valve control lines 23
10 reach the respective valves or the control flap 32. The fan 14 can also be controlled in this way. A typical structure of the control system provides that in the case of temperature T which is too high at least one of the two chilling systems has to be put into operation. In the case of an opened door or with an oxygen content which is below a specified threshold value, this can only be the
15 indirect chilling system. This is then operated until the temperature lies within a desired nominal range. In the case of a closed door and an oxygen content above the threshold value, the operation of the direct chilling system is often more favourable and is therefore triggered in the case of a temperature which is too high. If the oxygen content drops below the threshold value in the case of a
20 temperature which is still too high, then the indirect chilling system is switched over to or this is at least started.

- The interconnection and arrangement of the valves which is described in the present exemplary embodiment allows different operating modes, in which,
25 however, it is always possible to maintain an oxygen content above a specified threshold. If this threshold is suitably selected, then the interior space can be entered at any time or at least after an only short ventilating phase. Nevertheless, the fast-acting direct chilling system can be used on a large scale. This can be further improved by the threshold value of the oxygen content being lowered for
30 defined specified time periods in which entering of the interior space 3 is not necessary. This can be advisable for example for care of the vehicle's battery in

the case of night storage of the refrigerated goods or in the case of especially long travel distances between two loading or unloading points. For security, a door lock 28 is provided, which allows opening of a door 31 from outside only when the oxygen content in the interior space 3 lies above a specified threshold value.

- 5 As an additional improvement, a driver intervention circuit 24 can be provided as well, by which a driver of the transporting vehicle 1 manually initiates the creation of a breathable atmosphere in the interior space 3 shortly before reaching a loading or unloading point. Naturally, the initiation of such measures can also be automated, for example by using a navigation system which detects the
- 10 approach to a destination. The refrigerated container 2 can also have additional controllable means of ventilation, for example a ventilation flap 25 or an exhaust flap 26 which via ventilation flap control lines 27 can be used for supporting the quick creation of a breathable atmosphere. The overall system is to be generally suitable and be operated so that even in the case of loading and unloading
- 15 processes which follow shortly after each other stored refrigerated goods 30 do not thaw out. The conditions for this are very different, depending upon whether the interior space 3 is completely filled with refrigerated goods 30 or for example is almost empty. The instrumentation with sensors which is described and required for controlling, in conjunction with the measuring of the supplied
- 20 quantities of liquid nitrogen, and/or of the fan output power, enables good adaptation to the respective load state. If, for example, the oxygen content drops very quickly during direct spraying-in of a defined quantity of liquid nitrogen per unit of time, then a large volume of the available load can be deduced from it. Conclusions about the load and its surface can also result from the temperature
- 25 pattern in different chilling phases and warming-up phases. This enables an adaptation of the control and regulating unit to different states or even to a self-learning system.

- In all, the present invention enables an especially effective utilization of a store of
- 30 liquid nitrogen for chilling the interior space 3 of a refrigerated container 2 on a transporting vehicle 1. The use of the oxygen content as a controlled variable

increases the safety of the operating personnel despite using a direct chilling system as the preferred system.

List of designations

- 1 Transporting vehicle
- 2 Refrigerated container
- 3 Interior space
- 4 Tank for liquid nitrogen
- 5 Connecting line
- 6 First inlet valve
- 7 Feed line
- 8 Discharge line
- 9 Second inlet valve
- 10 Bypass line
- 11 Bypass valve
- 12 Heat exchanger
- 13 Primary side with heat exchanger mass
- 14 Fan
- 15 Environmental air inlet
- 16 Blow-off valve
- 17 Discharge line
- 18 Discharge openings
- 19 Discharge valve
- 20 Control and regulating unit
- 21 Oxygen sensor
- 22 Temperature sensor
- 23 Valve control lines
- 24 Driver intervention circuit
- 25 Ventilation flap
- 26 Discharge flap
- 27 Ventilation flap control line
- 28 Door lock
- 29 Unlocking line

- 30 Refrigerated goods
- 31 Door
- 32 Control flap

Patent claims

1. Method for chilling an interior space (3) of a refrigerated container (2), especially of a transporting vehicle (1) for refrigerated goods (30), wherein liquid
5 nitrogen is used as chilling medium, characterized in that the nitrogen in a direct chilling phase is sprayed directly into the interior space (3), wherein at least some of the nitrogen before spraying passes through a heat exchanger (12) with a heat exchanger mass (13) and cools this, and in that in an indirect chilling phase environmental air and/or air mixture from the interior space (3) is blown through
10 the cooled heat exchanger (12) into the interior space (3).
2. Method according to Claim 1, characterized in that during the indirect chilling phase, when required, nitrogen for cooling is furthermore directed through the heat exchanger (12) and then directed directly into the environment,
15 while environmental air and/or air mixture from the interior space (3) is additionally blown through the heat exchanger (12) into the interior space (3).
3. Method according to either of Claims 1 or 2, characterized in that the direct chilling phase is terminated and, with requirement for a further lowering of the
20 temperature, the indirect chilling phase is started, if the oxygen content in the interior space has dropped below a specified threshold value, for example below 15%, preferably below 12%.
4. Method according to one of the preceding claims, characterized in that during
25 the first chilling phase liquid nitrogen is fed to a feed line (7), which is provided with discharge openings (8), preferably in an upper region of the interior space (3), in such quantity that only some of the liquid nitrogen is sprayed through the discharge openings (8) into the interior space (3), while the remainder is fed through the feed line (7) to the heat exchanger (12) and leaves this through a
30 discharge line (17) which is provided with discharge openings (18) into the interior space (3).

5. Method according to one of the preceding claims, characterized in that the oxygen content in the interior space (3) is always kept sufficiently high to the extent that after opening a door (31) a person can directly enter the interior space (3) without any risk.
6. Method according to one of Claims 1 to 4, characterized in that all the doors (31) for access from outside to the interior space (3) are locked (28), provided that the oxygen content in the interior space (3) lies below a specified access value.
7. Method according to one of the preceding claims, characterized in that the direct and the indirect chilling phases take place essentially at the same time, wherein the ratio of the quantities of directly sprayed-in nitrogen and nitrogen which is used in the heat exchanger (12) is controlled in dependence upon the oxygen concentration in the interior space (3), while the chilling is altogether controlled in dependence upon the temperature in the interior space (3).
8. Method according to one of the preceding claims, characterized in that switching exclusively to the indirect chilling phase with exclusive feed of environmental air is automatically or manually initiated several minutes before an expected entering of the interior space (3).
9. Method according to one of Claims 1 to 8, characterized in that additional means of ventilation (25, 26) for feeding environmental air into the interior space, for example ventilation flaps or fans, are put into operation for a few minutes before an expected entering of the interior space.
10. Device for chilling the interior space (3) of a refrigerated container (2), especially of a transporting vehicle (1) for refrigerated goods (30), with a tank (4) for liquid nitrogen, a direct chilling system (7, 8, 17, 18) for spraying nitrogen into the interior space (3), and an indirect chilling system (12, 13, 14, 15) with a heat exchanger (12) which on the primary side is cooled by nitrogen and through which on the secondary side air mixture from the interior space (3) and/or

environmental air can be directed into the interior space (3), characterized in that the heat exchanger (12) on the primary side (13) can be connected in series to at least a section of the direct chilling system (7, 8, 17, 18).

11. Device according to Claim 10, characterized in that the direct chilling system
5 (7, 8, 17, 18) is equipped with a control circuit (21, 20, 6, 9, 19), the controlled variable of which is the oxygen concentration in the interior space (3) or a measured variable which is associated with it.

12. Device according to either of Claims 10 or 11, characterized in that the tank
10 (4) for liquid nitrogen, via a feed line (7) which is provided with discharge openings (8), is connected on the primary side (13) to the heat exchanger (12), so that some of the liquid nitrogen which is fed to the heat exchanger (12) can already be sprayed from the feed line (7) into the interior space (3), and in that the heat exchanger (12) on the primary side (13) has a discharge line (17) for
15 nitrogen, which is provided with discharge openings (18), through which nitrogen can be sprayed into the interior space (3) after exposure of the heat exchanger (12) to throughflow.

13. Device according to Claim 10, characterized in that the discharge openings
(8, 18) can be closed, or alternatively to the lines (7, 17) which are provided with discharge openings (8, 18) selectable closed lines (10, 11, 16) are available, for
20 the primary-side (13) cooling of the heat exchanger (12) by means of liquid nitrogen which can be discharged into the environment.

14. Device according to one of the preceding claims, characterized in that a
locking (28) of all the doors (31) for access from outside to the interior space (3)
25 is available, which can be released from outside only in the case of an oxygen content in the interior space (3) being above a specified access value.

15. Device according to one of the preceding claims, characterized in that the heat exchanger (12) has a heat exchanger mass (13) which has a thermal capacity

of 100 kJ to 5000 kJ, preferably of 200 to 1000 kJ.

16. Device according to one of the preceding claims, characterized in that additional means of ventilation (25, 26) are available for feeding environmental air into the interior space (3), for example ventilation flaps or fans, which, if
5 necessary, in interaction with an opened or partially opened door (31), can create a breathable atmosphere in the interior space (3) in 20 to 180 seconds, preferably in about 30 seconds.

17. Device according to Claim 16, characterized in that via a driver intervention circuit (24) the additional means of ventilation can be operated from a driver's cab
10 of the transporting vehicle (1).

18. Device according to one of Claims 10 to 17, characterized in that a control flap (32) is available, with which the ratio of environmental air which is fed to the heat exchanger (12) on the secondary side to air mixture from the interior space (3) can be adjusted.

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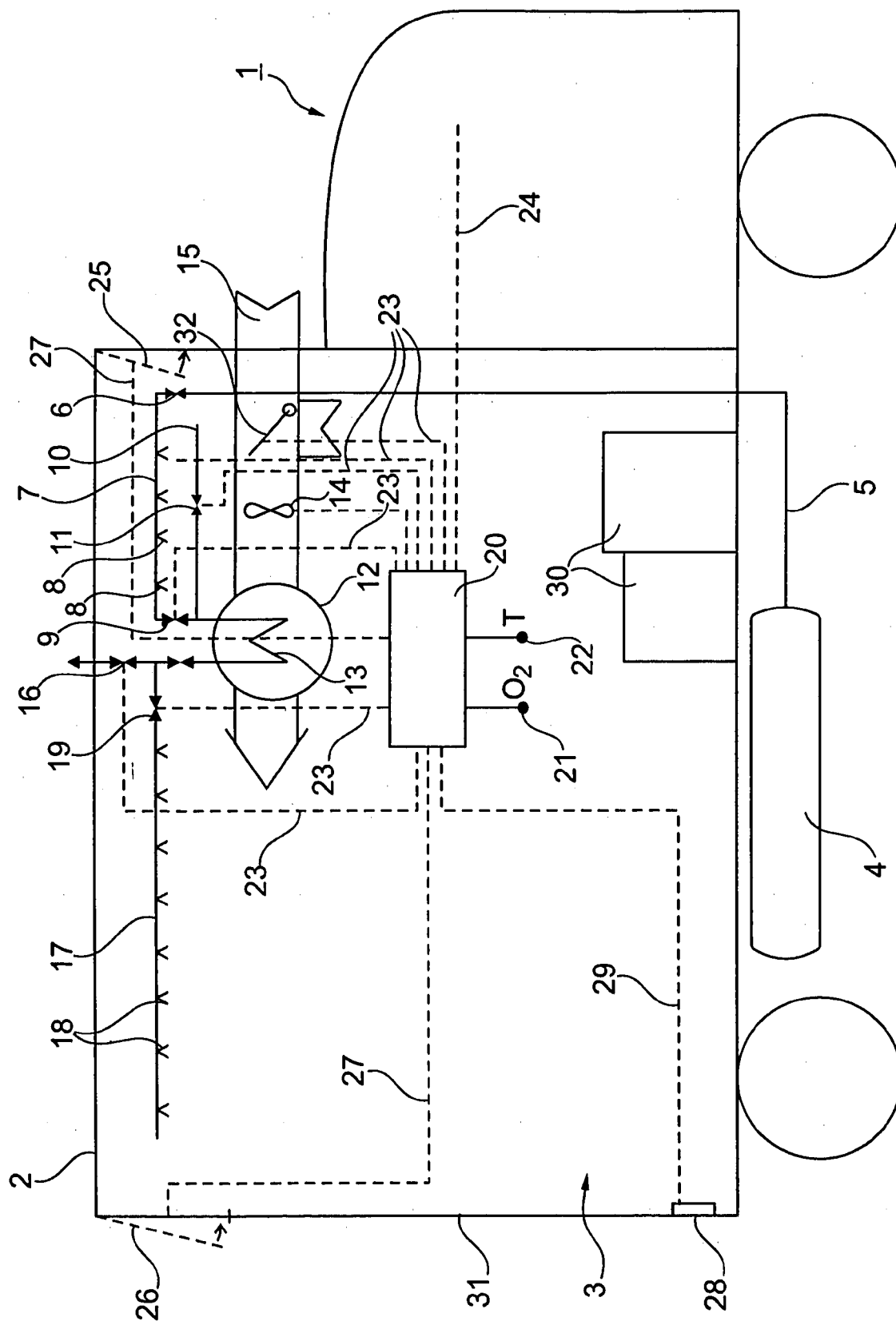


Fig 1

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/056849

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60H1/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 2008/116723 A (AIR LIQUIDE [FR]; AIR LIQUIDE DEUTSCHLAND GMBH [DE]; LUERKEN FRANZ [DE] 2 October 2008 (2008-10-02) the whole document	1,2,5,7,8,10,11
A	EP 1 252 471 B (PEDOLSKY HOWARD [US] UKRAM IND [US]) 15 November 2006 (2006-11-15) cited in the application the whole document	1,10
A	US 3 714 793 A (EIGENBROD L) 6 February 1973 (1973-02-06) abstract; figures	1,10
A	US 3 421 336 A (LICHTENBERGER HORST W ET AL) 14 January 1969 (1969-01-14) abstract; figures	1,10
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search

18 August 2009

Date of mailing of the international search report

24/08/2009

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/056849

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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